METHOD AT A GAS BURNER AND A COMBINED GAS BURNER AND COOLER.

The present invention relates to a method pertaining to a burner and to a burner-cooler combination.

More specifically, the invention relates to a method of reducing material wear in the operation of furnace-heating burners. The burner concerned may be a gas burner, an oil burner or a solid fuel burner.

The invention is exemplified below with reference to a combined gas burner and cooler.

Furnaces are often heated with the aid of a gas burner. This burner will typically consist of a gas source from which gas is lead through a nozzle and then ignited to provide a flame. The extremely hot gases of combustion are led through an open-bottom inner pipe. The inner pipe is surrounded by a closed-bottom outer pipe so as to form a closed pipe system. The waste gases are led out through the upper part of the outer pipe. The pipe system is situated in the heated furnace volume and there contributes to the heating process by transferring the heat generated by combustion to the heated volume of the furnace, primarily by thermal radiation.

Because the internal volume of the pipe system is not in contact with the heated furnace volume, the combusted gas or its combustion products will never come into contact with the products to be heated in the furnace.

A temperature of 500-1100°C is a typical working temperature of such a furnace.

When the product heated in the furnace is ready to be removed therefrom, it will, of course, take a considerable length of time for the furnace, its heated volume, and the heated product to cool down to a temperature at which they can be handled without the aid of special tools. In order to hasten the furnace cooling process, cold air is often pumped into the inner pipe so as to cool down the heated furnace volume actively, by transferring the heat stored in the heated furnace volume to the cold air via the outer pipe.

In this type of operation, the outer pipe of the gas burner is named a "cooling finger". The cooling air is thus led through the same pipe system as that in which the gas burner is included while the gas and fuel supply is switched off during this process, and there is opened instead an air supply source from which cooling air flows through the pipe system. The cooling air flow will often have a very large volume. For instance, the volume of cooling air used when cooling the furnace is typically 100 m^3/h.

At times, the arrangement is used solely as a cooling finger.

Since the temperature of the cooling air is, of course, much lower than the temperature of the atmosphere in the heated furnace volume, and since the cooling air does not communicate directly with said atmosphere, those parts of the pipe system that constitute the barrier between the cooling air and the heated furnace volume will be subjected to strong material stresses. These stresses are sufficiently powerful to cause significant mechanical stresses in the joins between the different parts of the pipe system constituting said barrier.

In the case of known techniques, the cooling air is led through the inner pipe that opens into the outer pipe which is in direct contact with the enclosed furnace volume and through which the cooling air further passes and exits from the pipe system. In the region where the cooling air exits from the inner pipe and turns and flows back through that part of the outer pipe volume that is not accommodated by the inner pipe volume, the cooling effect is relatively strong. Consequently, the stresses on the material resulting from the powerful temperature gradients that occur in the outer pipe material will be significant in this region, the bottom construction of the outer pipe being particularly subjected to such stresses. The bottom construction will often consist of a bottom plate which is firmly fixed mechanically in the outer pipe. Material wear in the joints between said bottom plate and the barrel surface of the outer pipe will be significant regardless of how the bottom plate is secured, i.e. by welding, screwing, etc., such wear also being caused by cyclically varying loads which lead to thermal fatigue.

Other solutions to these problems have been proposed. For instance, one solution proposes that the outer bottom plate is given a curved shape so as to take-up more effectively those

material stresses that are applied to the construction by the temperature gradients that occur in cooling finger operations.

However, none of the presented proposals has led to an effective solution to the problem. The outer pipe and/or the bottom plate must still be replaced relatively often, with unnecessary high maintenance costs as a result.

Consequently, it is desirable to find an outer pipe bottom construction that will minimise material wear resulting from the temperature gradients that occur in said construction, therewith reducing the maintenance requirements on the gas burner and increasing its length of life.

The present invention provides such an improved bottom construction for the outer pipe of such a gas burner, by including an inner bottom surface which is spaced from the outer pipe surface and against which the through-flowing cooling air is forced to turn back and flow out through the outer tube, whereby the cooling air will never flow in direct contact with the joints between the outer pipe surface and the barrel surface of the outer pipe.

In addition to increasing the useful life of a gas burner, the invention also solves a problem concerning the actual choice of material for construction of the gas burner pipe system. It is desired to use a ferritic material such as FeCrAl in many applications, instead of an austenitic material, such as NiCr. FeCrAl is a better material from the aspect of oxidation and corrosion.

This is because, for instance, FeCrAl is better able to handle decarburization of the material occurring as a result of the differences in carbon potential between the material and the enclosed furnace volume. Such is the case, for instance, when operating burners of the so-called SER type. On the other hand, it is not possible to construct a gas burner according to present technology from a ferritic material, due to the material stresses that occur as a result of the presence of said temperature gradients. Because the present invention is effective in reducing material loads induced by temperature gradients, it is now possible to use ferritic material for the manufacture of gas burners instead of austenitic material.

Thus, the present invention relates to a method in the operation of a burner and/or a cooler in which gases are caused to flow through an inner pipe, out through an outer pipe which surrounds the inner pipe, and back through that part of the outer pipe volume that is not accommodated by the inner pipe volume, wherein the method is characterised by placing an inner bottom plate in the outer pipe in spaced relationship with the closed bottom of the outer pipe, and forcing the gases flowing through the inner pipe and out into the outer pipe to turn and flow back and out between the outer pipe and the inner pipe, thereby creating a thermal insulating gas pocket between the gas and the bottom of the outer pipe.

The present invention also relates to a gas burner/cooler combination of the kind defined in Claim 8 and having the characteristic features set forth in said Claim.

The invention will now be described in more detail partly with reference to the embodiment of the invention shown in the accompanying drawings, in which

- Fig. 1 is an overview of a furnace that includes a gas burner;
- Fig. 2 is a side view of the burner pipe/cooling finger of said burner;
- Fig. 3 is a side view of the lower part of the gas burner and a view projected from the underside of said burner; and
- Fig. 4 is a side view of the lower part of another gas burner, and a view projected from the underside of said burner.

Fig. 1 is an overview of a furnace 1 heated by a combined gas burner and cooler 3 constructed in accordance with the invention. Fig. 2 is a side view of said combined gas burner/cooler. The enclosed furnace volume 2 is heated by thermal energy delivered from the gas burner 3. The thermal energy obtained from the gas burner 3 is transmitted to the enclosed furnace volume 2 primarily by thermal radiation, although convection and conduction may also contribute towards heating of the furnace volume.

Gas from an external gas source is ignited in a burner head 4 and the hot, gaseous residual products from the combustion process flow into the inner pipe 7 of the burner and back out through the volume 6 formed between the outer surface of the inner burner pipe 7 and the inner surface of the outer pipe 5.

The gas combustion products will thus never come into contact with the enclosed furnace volume 2.

As indicated above, it is also usual to use cooling air in the same pipe system for cooling purposes. In this case, the gas burner 3 is called a cooling finger instead. Thus, the cold air that flows through the construction when the burner 3 is used as a cooling finger will not come into contact with the enclosed volume 2 of the furnace either.

Fig. 3 illustrates the lower part of the gas burner 3. As will be seen from the figure, a circular inner bottom surface 8 is placed at a distance above the bottom plate 9 of the outer pipe 5. An insert 10 defines the distance between the inner bottom surface 8 and the bottom plate 9 of the outer pipe 5. The insert 10 may be tubular or may be of any other suitable geometric shape. The insert will beneficially have a low heat conductivity and the smallest possible cross-sectional area.

The diameter of the inner bottom plate 8 does not correspond fully to the inner diameter of the outer pipe 5, therewith forming an open gap 11 between the inner bottom surface 8 and the inner surface of the outer pipe 5. This gap ensures that material movements caused by the temperature gradients occurring in operation will not cause mechanical damage to the material, and then particularly to the means with which the bottom plate 9 is secured in the pipe system.

The spacing between the inner bottom plate 8 and the bottom plate 9 of the outer pipe 5 creates an insulating air gap 12. The gases that flow out from the inner pipe 7 and back into the volume between the inner pipe 7 and the outer pipe 5 are obstructed by the upper surface of the bottom plate 8, wherewith there will be a significant reduction in the effect that the temperature difference existing between the enclosed furnace volume 2 and the gases flowing through the burner 3 as on the volume beneath the inner bottom plate 8. This results in a significant reduction in the extent to which the bottom construction 9 of the outer pipe 5 is heated and cooled respectively. This, in turn, results in a reduction in the material wear due to material stresses induced by thermal gradients, and also in a significant increase in the useful length of life of the bottom construction 9 of the outer pipe 5.

Located on top of the inner bottom plate 8 is a cruciform spacer 13 which functions partly to define the distance between the inner bottom plate 8 and the bottom edge of the inner pipe 7 and partly to uniformly distribute the gases exiting from the inner pipe 7. The inner pipe 7 rests on the spacer 13. It is important to note that this construction may be any construction whatsoever that will achieve at least one of these two purposes.

Alternatively, the spacer 13 may be omitted, wherewith said purposes will not be achieved.

It will also be understood that depending on the construction of the remainder of the burner and provided that either the inner bottom plate 8 and the circular insert 10 or the circular insert 10 and the bottom construction 9 of the outer pipe 5, or both of these combinations, rest loosely on top of each other, so can the insert 10, the inner bottom plate 9, the spacer 13 (when present) and the inner pipe 7 may be joined together mechanically, for instance as by welding, clamping, screwing or in some other appropriate manner. The components may, alternatively, rest loosely one on the other.

Fig. 4 is a view similar to that of Fig. 3, but illustrating another possible embodiment of the invention. In this embodiment, there is used a convection and radiation reducing insulating material 14 instead of the circular insert 10. The insulating material provides still better insulation of the bottom construction 9 of the outer pipe 5, resulting in a still longer length of useful life. Moreover, the insulating material 14 defines the distance between the upper surface of the bottom construction 9 of the outer pipe 5 and the lower surface of the inner bottom plate 8, and also supports the weight of the inner bottom plate 9.

As will be understood, insulating material 14 may also be used in combination with an insert 10 so as to enhance the bearing capacity of the construction.

Aluminium silicate fibre is an example of an appropriate insulating material in respect of the present application.

The insert may be metallic or ceramic or may comprise some other suitable material.

It will be obvious that the present invention solves the problems mentioned in the introduction.

Although the invention has been described with reference to a number of embodiments thereof, it will be evident that the design of the structural components can be varied.

The present invention shall not therefore be considered to be limited to the aforedescribed exemplifying embodiment thereof, since variations can be made within the scope of the accompanying Claims.